DDF Annual Report

**Title of Investigation:**

**Three-Dimensional Planetary Topography Visualization: A Valuable Tool for Informal and Special Needs Education**

**Principal Investigator:**

**John Keller (Code 691)**

**Other In-house Members of the Team:**

**Herb Frey (Code 921)**

**Other External Collaborators:**

**James Roark (Science Systems and Applications Inc. [SSAI]); Susan Sakimoto (University of Maryland-Baltimore County); Stephanie Stockman, (SSAI), and Steven Williams (National Air and Space Museum)**

**Initiation Year:**

**FY 2004**

**Aggregate Amount of Funding Authorized in FY 2003 and Earlier Years:**

**$0**

**FY 2004 Authorized Funding:**

**$15,000**

**Actual or Expected Expenditure of FY 2004 Funding: In-house:**

**$5,000**

**Status of Investigation at End of FY 2004:**

**To be continued in FY 2005 with funds remaining from FY 2004 and earlier years**

**Expected Completion Date:**

**March 30, 2005**

**Purpose of Investigation:**

The purpose of the investigation is to develop three-dimensional (3-D) physical models and graphics that give the general public, including students of all ages and those with special needs, a deeper understanding of planetary topography. These models and graphics would be used during formal and informal educational settings at the National Air and Space Museum and other institutions.

**FY 2004 Accomplishments:**

The National Air and Space Museum (NASM) is the most popular museum in the world, with more than 10 million visits annually. The museum augments its exhibits with "Discovery Stations," interactive, temporary exhibits built around a touchable artifact or hands-on activity. Stations are popular with the general public and school groups. One such station is called "WHAT are You

Looking At?" located in the "Looking at Earth" gallery. The station helps visitors to understand image interpretation, camouflage, and other basic remote-sensing concepts. Physical terrain models and computer graphics, which we are developing, would be very useful tools to help the visitor understand the relationship between the shape of a planet's surface and the means by which those data are typically presented. Furthermore, they would augment the station's materials on the trade-offs between data quality (spatial resolution) and data costs. In addition, physical terrain models would allow visually impaired visitors an opportunity to feel the basic characteristics of specific landforms and to compare similar landforms on different planets.

In carrying out this project, we modified the display software program GRIDVIEW for planetary topographic research so that it could be used with a tablet computer. In particular, we simplified the interface for use at the NASM discovery stations and we bought a tablet computer. We spent much of the summer developing and testing software. In September 2004, we delivered the tablet computer, which we loaded with the software.

Currently, the tablet computer and the solid 3-D models are undergoing operational testing in the classroom environment at the Udvar-Hazy Center (UHC) in Chantilly, Virginia, under the supervision of UHC Chief of Education, Doug Baldwin. We found that the level of background knowledge required, the learning curve associated with the controls (both for the visitor and for the staff/volunteer tending the activity), and the fragility of the tablet computer made the setup difficult to use on the museum floor in a Discovery Station-type environment.

The mode of operation currently being tested is to give selected groups of older students opportunities to work with the program in more formal educational settings. While they are manipulating the program, we closely supervise their interaction to determine what they pick up and what we need to do to further explain or simplify the user interface. UHC also supervises the efforts of those involved in our Aerospace Educators-in-Residence program. This group of in-service teachers is temporarily detailed to our team to help us develop and deliver educational programming that is aligned with national standards. These teachers are currently assessing the software to determine its "teacher friendliness" and the kinds of curriculum support it could provide.

A parallel effort of outreach was conducted during last year. Models were displayed or distributed at a number of events including:

- January 2004: Grand opening of the Research and Training Institute, Baltimore, Maryland
- June/July 2004: National Federation of the Blind Convention, Atlanta, Georgia
- July 2004: Goddard Community Day, Greenbelt, Maryland (10,000 people attended)
- October 2004: NASA Explorer Institutes for the National Park Service interpreters at Goddard and at the Mather Training Center in Harpers Ferry, West Virginia
- October 2004: Girl Scouts USA program at the Jet Propulsion Laboratory. We provided 15 pairs of Olympus Mons/Hawaii volcanoes to the Girls Scouts for use by Girls Scout councils
- November 2004: Regional National Science Teachers Association meeting in Indianapolis, Indiania, for a NASA Explorer School Student Symposium short course on Solar System Exploration

Finally, the software for converting topographical data to the stereolithography (STL) format, which rapid prototyping machines use, was released to the public through the technology transfer office. This effort removes any impediment for outside companies to commercialize 3-D model-making models available to the wider educational community.

**Planned Future Work:**

We have introduced use of solid 3-D models representing scientific data as a tool for education and public outreach (EPO). We will continue to support the development of this technology in the future and will participate as collaborators on EPO for future scientific investigations. For example, the use of solid models has been included as part of the EPO component for the Lunar Orbiter Laser Altimeter (LOLA) instrument on for the upcoming Lunar Reconnaissance Orbiter mission.

**Summary:**

The topographic models are visually appealing and instantly engage those who handle them. They provide significantly improved representation of the three-dimensional character of a planetary surface, which is often difficult to visualize with two-dimensional maps. The technology, for example, is ideal for visualizing topographical data gathered with the Mars Orbiter Laser Altimeter (MOLA), a Goddard-developed instrument, and could become a standard part of future outreach projects. By commercializing the technology, we allow broader access to the models. Although we developed a significant portion of this work for a museum setting, we found that the level of background knowledge required, the learning curve associated with the controls (both for the visitor and for the staff/volunteer tending the activity), and the fragility of the tablet computer made the setup difficult to use on the museum floor in a Discovery Station-type environment. As stated above, we are currently testing the software for more formal education settings.